

2.6 Partnerships

Partnerships are integral to the NIOSH Mining Program. They facilitate advances in the safety and health of U.S. mine workers. Input from customers and stakeholder groups, which have inherent knowledge and concern about the health and safety of miners, helps in setting research priorities. Collaborative research with our partners provides in-kind contributions, such as equipment and test mine sites, to extend our research dollars in conducting research. The partners often add expertise or specialized experience to the research team, which is beneficial to the research experiments and analysis and interpretation of the results. This added expertise enhances the research program and also allows for more rapid transfer of knowledge and products to the mining industry. Some of the partners that provide input are:

Labor:

- United Mine Workers of America (UMWA)
- United Steelworkers of America (USWA)
- International Union of Operating Engineers (IUOE)

Industry:

- Bituminous Coal Operators' Association (BCOA)
- National Mining Association (NMA)
- National Stone, Sand and Gravel Association (NSSGA)
- Industrial Minerals Association-North America (IMA-NA)
- Northwest Mining Association (NWMA)

In addition, a number of state organizations, universities, manufacturers, and government agencies participate in research partnerships and provide important input to our research priorities.

Our partnerships can be grouped into three categories. Some examples of these partnerships are presented below in each category.

1. Partnerships with important customers and stakeholders to identify research needs and transfer research findings.

Noise Partnership - Noise-induced hearing loss (NIHL) moved to the forefront of health-related issues within the mining industry in the late 1990s. This culminated with the passage of a new noise rule in 1999 (30 CFR 62) that was enforced by the Mine Safety and Health Administration (MSHA) starting in 2000. Because of the new rule, a Noise Partnership was formed by NIOSH. The partnership included the UMWA, BCOA, NMA, MSHA, and several mining equipment manufacturers and suppliers. The partnership is providing opportunities for collaborative research with stakeholders (mine operators, labor officials, equipment manufacturers, regulatory officials, etc.) related to the Hearing Loss Prevention Program at NIOSH's Pittsburgh Research Laboratory (PRL). The goal of the program is to reduce noise exposures to the nation's miners through research efforts associated with worker noise exposure and related sources, noise control technologies, worker empowerment and education, and improved hearing protection devices. The partnership is expediting progress toward achieving the goals of the program.

Diesel Partnerships - In January 2001, MSHA promulgated two rules regulating the exposure of underground coal miners (30 CFR 72) and metal/nonmetal miners (30 CFR 57) to diesel particulate matter (DPM). Labor and industry were concerned with the ability of current control technologies to reduce DPM concentrations in mine air below those mandated by these regulations.

In early 2000, in anticipation of the proposed rulemaking, the UMWA, BCOA, NMA, and NIOSH formed the Coal Diesel Partnership. Although not an official member of the partnership, MSHA worked closely with the partnership to advance the state of technology through both lab and in-mine testing of control technologies. NIOSH's role was to provide the partners with a scientifically sound evaluation of diesel emission control technologies in underground coal mines.

All parties involved in the partnership bring something of value to the effort. Industry, through the BCOA and NMA, has made mines available to NIOSH for testing control technologies. This has often required investing time, money, and effort into preparing controlled test sites ventilated with fresh air. Industry has also independently conducted testing of various available control technologies and provided test findings to the partnership. In addition, industry has purchased a number of control technologies for testing done under the partnership. The UMWA has worked closely with NIOSH in locating acceptable mine test sites and obtaining cooperation from miners in conducting the in-mine testing. Knowledgeable diesel experts from both labor and industry have worked with NIOSH to put together test protocols, locate potential control technologies, and review and analyze test results. MSHA has assisted in underground testing and conducted tests of control technologies at its Approval and Certification Center in Triadelphia, WV.

All parties in the Coal Diesel Partnership have benefited by reducing individual costs, avoiding duplication of effort, and being able to evaluate a relatively large number of diesel control technologies in a short period of time. In the effort to disseminate emission control information to the industry, the partnership sponsored an open industry workshop on the state of the art of diesel emission control technologies in coal mines. The partnership efforts continue with preparations for evaluating various control technologies at NIOSH's Lake Lynn Experimental Mine. A committee was recently appointed to work with engine, vehicle, and aftertreatment manufacturers in overcoming barriers to the introduction of clean engine technology into coal mines.

In early 2002, the success of the Coal Diesel Partnership prompted the formation of a Metal/Nonmetal Diesel Partnership. The goal was to address various issues related to implementing diesel control technologies in metal/nonmetal mines. Members of this partnership are the USWA, NMA, NSSGA, the MARG Diesel Coalition, IMA-NA, and NIOSH. Although not officially a member of the partnership, MSHA has actively participated in all partnership activities. The Metal/Nonmetal Diesel Partnership, similar to its coal counterpart, has proved that this kind of partnership is efficient in addressing complex health and safety issues. Work has been accomplished that benefits all involved parties while sharing costs and avoiding duplication of efforts. Industry and labor have worked closely with NIOSH in locating mine test sites, reviewing test protocols and test results, conducting underground testing of control technologies, and sponsoring two diesel emission control technology workshops. One accomplishment was a series of studies in an operating metal/nonmetal mine to evaluate several control technologies. Additional studies are planned in the near future. Work under the partnership resulted in findings that helped MSHA decide to use elemental carbon rather than total carbon as the surrogate for total DPM.

Comprehensive information on selecting and implementing diesel particulate filter systems has been supplied to the industry through a Web-based diesel filter selection guide available from both the NIOSH and MSHA websites. NIOSH is hosting a diesel list server that allows free exchange of information on diesel emissions and controls.

Both the Coal and the Metal/Nonmetal Diesel Partnerships demonstrate how labor, industry, and government can benefit from working together toward a common goal - reducing the exposure of underground miners to diesel engine emissions.

2. Partnerships with manufacturers and mining companies to conduct research and develop products.

Personal Dust Monitor Partnership - The NIOSH Pittsburgh Research Laboratory, in partnership with the UMWA, BCOA, and NMA, has been working to develop a personal dust monitor (PDM) that will provide real-time dust exposure data to miners. This partnership has also had assistance from MSHA. The actual development was done through a research contract with Rupprecht & Patashnick Co., Inc. (now Thermo Electron Corp.), whose commitment to this effort has been important to its success. The concept was to develop a person-wearable dust monitor that provides both real-time and end-of-shift dust exposure data, empowering both miners and management to take action to prevent overexposures to respirable dust.

The evolution of this new dust monitoring technology is a product of this partnership effort. From the start of the partnership in early 1999, there was agreement among all partnership members as to the conceptual design of the PDM and its intended fundamental capabilities. There has also been a commitment on the part of all partnership members to work toward the development of a technology that will make a difference in improving the health of U.S. coal miners. Each member of the partnership has contributed to advancing the development of the PDM to its current status. The BCOA and NMA have made mines available to NIOSH for testing of prototype PDM units. The UMWA has provided the support of its mining membership by cooperating in the conduct of underground testing and providing miner feedback on daily use of the PDM units. NIOSH has committed financial and personnel efforts to the design, development, and testing of the PDM concept. MSHA has provided assistance in facilitating intrinsic safety testing and approval and has participated in underground testing. All partners in this effort have taken an active role in the review of lab and in-mine test protocols, review of PDM performance results, and numerous meetings to discuss design improvements to the PDM to make it more mine-worthy and user-friendly. The rapid advance in PDM technology exemplifies how labor, industry, and government can work together in partnership to improve safety and health in the mining industry.

Bridger Coal Co. Partnership - Work-related musculoskeletal disorders (MSDs) have long been identified as a problem within the mining industry. These disorders result from exposure to MSD risk factors. Studies have shown that at least 35% of mine workers were potentially exposed to overload conditions affecting the neck, back, forearms, arms, shoulders, fingers, and hands.

A recently completed NIOSH project involved partnering with Bridger Coal Co. to implement an ongoing, effective process to reduce exposure to work-related MSD risk factors at the Jim Bridger surface coal mine in Wyoming. NIOSH's role was to guide and direct Bridger in customizing and implementing a sound ergonomics process that the company can build upon

and continue to benefit from for years to come. The main objective was to develop an ergonomics process that emphasized employee participation. First, a company ergonomics committee was established. NIOSH then gave awareness training to all Bridger Coal employees that focused on recognizing MSD risk factors and how to take action by reporting risk factors to the ergonomics committee. During the first 3 years of using the process, the committee implemented more than 20 job improvements. Instead of waiting for an injury or illness to occur before making changes, Bridger Coal now relies on this employee-based participative process to implement interventions that promote the well-being and safety of its employees. In addition to responding to employee reports of risk factors, the committee is also applying its ergonomics knowledge and awareness to other processes, such as purchasing equipment, implementing new procedures, and developing new training. Work under this partnership has shown that establishing a comprehensive ergonomics process is the best way to reduce injury and the cost of injury, as well as to improve work performance.

Proximity Warning Technology Collaboration - In addition to the more structured partnerships, the mining program has dozens of research and development collaborations involving various combinations of mining companies, equipment manufacturers, labor organizations, universities, and other state and federal agencies.

An example of research involving a number of collaborators is the study of proximity warning systems to reduce serious injuries and fatalities that can be attributed to the lack of visibility around large off-highway mining equipment. These accidents account for 12% of all surface mine fatalities. In 1998, MSHA proposed rules requiring some type of sensor-based collision warning system and cameras to monitor blind areas around mining equipment. At that time, no sensor-based technology had been thoroughly tested on large, off-highway mining equipment, and cameras had been applied only to a limited extent. NIOSH proposed that a test program be initiated for off-the-shelf collision warning systems to see how they performed on mining equipment prior to the finalization of any rules.

Since then, NIOSH has provided regular updates to MSHA regarding available proximity warning systems and their effectiveness in the surface mining environment. NIOSH has also provided information for MSHA training materials and an MSHA web page describing available systems. In August of 2005, NIOSH partnered with MSHA in organizing an open industry briefing on proximity warning systems that was attended by 120 mining professionals representing industry, equipment manufacturers, sensor manufacturers, and other research organizations. NIOSH and MSHA have successfully worked together to understand the applications and limitations of proximity warning systems on mining equipment, providing a rational background for regulatory action.

Another collaborator in this work is Phelps Dodge, Inc., which has provided access to equipment and facilities for the past 5 years at its Morenci, AZ, copper mine. Various proximity warning technologies have been tested for months at a time at this location, providing necessary information on the limitations and strengths of the systems. Feedback from truck drivers, alarm data, and video footage from the cameras mounted on the trucks has provided measures for effectiveness. The company has used NIOSH test results to make decisions regarding which technologies will be implemented on its fleet of trucks at all mining properties.

Collaborative work with the Colorado School of Mines has provided the means to study high-tech innovative solutions to proximity warning. Its work in underground load-haul-dump automation led to the development of a computer-assisted stereovision system that could detect the location and shape of a muck pile. The system could also distinguish between workers and other objects in the environment. NIOSH proposed that this system be tested for use in proximity warning for surface mining equipment, and a prototype system was built and tested in a quarry. These proof-of-concept tests showed potential for providing a system that could detect obstacles and provide a view of blind areas using only cameras. A startup company was formed by the university researchers and is further developing this and related technologies.

NIOSH also worked with Trimble, Inc., to develop a proximity warning system based on the global positioning system (GPS). Surface mines already use GPS to track and dispatch mobile equipment. NIOSH researchers proposed adding a safety function to existing dispatch systems that would allow each truck driver to know the location of nearby obstacles, equipment, and passenger vehicles. By working with Trimble, the cost to develop the system was minimal because all the components and functionality were already implemented in its mining dispatch system. A prototype system was successfully tested on a dump truck, a dozer, and two light vehicles at Phelps Dodge Morenci, Inc.

Preco Electronics, Inc., worked with NIOSH to test its radar-based proximity warning system at a surface mine. Test results showed that the original radar system needed to be modified to provide an adequate detection area around large trucks. NIOSH worked with Preco to define the detection characteristics needed, and the company is now marketing a heavy-duty system that uses multiple antennas to detect obstacles at the front and rear of large trucks and other equipment. NIOSH tests also resulted in recommendations that passive sensor technologies should be used in combination with camera systems so the source of all warning alarms could be verified by the driver. Preco is now marketing a combined radar and camera system.

NIOSH researchers were asked to demonstrate their test procedures for a committee of the International Standards Organization that was developing ISO standard 16001 - "Earth-Moving Machinery - Hazard Detection and Visual Aids - Performance Requirements and Tests." The NIOSH procedures were used to define tests for determining the detection characteristics of radar and radio transponder-based systems. NIOSH researchers are participating on the ISO committee to further develop this and other safety-related standards for heavy equipment.

3. Partnerships with organizations to exchange safety and health information and technology and to conduct research in areas of mutual benefit.

Global Mining Research Alliance - The global mining industry presents some of the most complex and demanding scientific, engineering, and technical challenges in the world today as it attempts to meet resource needs in a cost-effective and environmentally sustainable manner while improving the safety and health of its workers. To help meet these challenges, several mining research organizations throughout the world have joined together to form the Global Mining Research Alliance (GMRA). This collaboration aims to become the supplier of choice for mining research solutions and knowledge in the international mining and resources industry. The partners forming the alliance are:

- Canada Centre for Mineral and Energy Technology, Mining and Mineral Sciences Laboratories (CANMET-MMSL)

- Council for Scientific and Industrial Research (CSIR) Miningtek (Republic of South Africa)
- Commonwealth Scientific and Industrial Research Organisation (CSIRO) Exploration and Mining (Australia)
- National Institute for Occupational Safety and Health (NIOSH) (United States)

The GMRA collaboratively pools together the above organizations' mining research expertise and lab facilities. It undertakes cooperative research designed to benefit the industry in technologies associated with mineral exploration and resource management, extractive technologies, ground control, occupational health and safety, equipment automation, mineral processing, and the environment. Its customers are domestic and multinational mining corporations, industry associations, governments, multilateral agencies, and industry stakeholders. The principal objectives of GMRA include (1) improving the work environment for mine workers by researching and developing technologies that lead to sustainable industry practice, (2) sharing expertise and facilities among the GMRA partners, (3) providing economic leverage to funding by reducing duplication and coordinating research efforts in order to increase the probability of success, and (4) providing improved opportunities for career development through staff exchanges between the GMRA partners.

Council for Scientific and Industrial Research of South Africa - During the past 3 decades, the South African coal mining industry has experienced a series of explosions leading to a considerable loss of life. Over the past 4-5 years, research was done to develop a bagged stone dust barrier to prevent a coal dust explosion from propagating. In South African coal mines, multiple-entry mining methods are used, but little was known of how explosions propagate under these conditions. It was essential to determine whether or not bagged stone dust barriers can effectively suppress coal dust explosions in room-and-pillar sections. The Council for Scientific and Industrial Research (CSIR) of South Africa requested technical assistance in the full-scale testing of these passive barriers to suppress dust explosions in coal mines. NIOSH's Lake Lynn Experimental Mine (LLEM) was the only facility in the world that could perform the required full-scale evaluations in a multiple-entry mining configuration. The evaluations were successfully completed in the LLEM during 1999-2000. Two barrier designs were evaluated: the distributed barrier configuration and the concentrated barrier configuration. From the full-scale experimental mine test results, it was concluded that both bagged barrier designs were effective in stopping coal dust explosions in the multiple entries of the LLEM. Based on the results of these tests, the South Africans have implemented these barriers to protect miners from underground explosions. Further tests are planned with rock dust barriers that contain a small explosive charge, which is triggered by an approaching flame front to disperse the rock dust and extinguish the explosion.